PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark Office, PCT
2011 South Clark Place Room CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 13 March 2001 (13.03.01)	
International application No. PCT/GB00/02573	**Applicant's or agent's file reference** N.76350A MN
International filing date (day/month/year) 05 July 2000 (05.07.00)	**Priority date** (day/month/year) 09 July 1999 (09.07.99)
Applicant BENJAMIN, Simon, Charles	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

25 January 2001 (25.01.01)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Pascal Piriou
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
N.76350A MN		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/GB00/02573	05/07/2000	09/07/1999
International Patent Classification (IPC) or national classification and IPC G06N1/00		
Applicant ISIS INNOVATION LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 12 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25/01/2001	30.07.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Borotschnig, H Telephone No. +49 89 2399 7459

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/02573

I. Basis f the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-13 as originally filed

Claims, No.:

1-29 as originally filed

Drawings, sheets:

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 29.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☒ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 29 are so unclear that no meaningful opinion could be formed (*specify*):
see separate sheet

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N) Yes: Claims 7-8,11-23,27

	No:	Claims	1-6,9-10,24-26,28
Inventive step (IS)	Yes:	Claims	16-23
	No:	Claims	7-8,11-15,27
Industrial applicability (IA)	Yes:	Claims	1-28
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

R It m III

Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1 Due to the wording of claim 29 ("substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings") the intended scope of protection remains completely unclear and it is thus not possible to arrive at definite conclusions concerning the status of the claimed subject matter vis-à-vis the teachings of the prior art (cf. also the objections under Item VII).

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

2 Reference is made to the following documents:

D1: Los Alamos National Laboratory Preprint:
INTERNET http://xxx.lanl.gov/pdf/cond-mat/9808243 21 August 1998
'Cellular Structures for Computation in the Quantum Regime' S.C. Benjamin and N.F. Johnson XP002149950

D2: LENT C S ET AL: 'Quantum cellular automata' NANOTECHNOLOGY, JAN. 1993, UK, vol. 4, no. 1, pages 49-57, XP000946209 ISSN: 0957-4484

D1 is a publication co-authored by one of the inventors and is considered as representing the closest prior art.

3 The subsequent analysis assumes that the observations made in Item VIII concerning the expression "a state transformation signal to which each addressed unit cell responds" have been taken into account by adopting a formulation similar to the one exemplified in Item VIII. This assumption is made in order to cover all essential features in the following discussion (Dropping the assumption would not change the results of the following assessment as the claims are broad enough to also cover global updating in addition to individual access. In addition, D1 would disclose already one possibility of how one might additionally also implement the functionality of addressing cells individually: pg. 8

lines 3-9: ("driving a quantum dot through its internal states by laser pulses": individual access results focussing individual pulses on different quantum dots)).

4 The subject matter of claim 1 is known from D1, pg. 3 lines 3-15, Fig. 3a and pg. 4 lines 2-3; pg. 5 lines 15-28 which discloses a data processor comprising an array of unit cells of only two different types (ibid. pg. 5), the two different types of unit cell being arranged alternately in the array (ibid. Fig. 3a), each unit cell having first and second distinguishable states (ibid. Fig. 3a: α,β) and means for independently addressing the two types of unit cell with a state transformation signal to which each addressed unit cell responds by undergoing a state transformation selectively in dependence upon the states of its nearest neighbours in the array (ibid. pg. 5).

4.1 As to claim 2: D1 also discloses a data processor according to claim 1 wherein the state transformation is applied in dependence upon whether the addressed unit cell's nearest neighbours are in mutually the same state or mutually different states (ibid. "field").

4.2 As to claim 3: D1 also discloses a data processor according to claim 1 or 2 wherein the means for independently addressing the two types of unit cells addresses each type of unit cell by applying to the whole array the state transformation signal in the form of a physical stimulus to which unit cells of the other type are substantially inert (ibid. and pg. 8: pumping/laser pulses or external magnetic field for spin switches).

4.3 As to claim 4: D1 also discloses A data processor according to claim 1,2 or 3 wherein the array is one dimensional, consisting of a line of unit cells of alternating type (ibid. Fig. 3a).

5 The subject matter of claim 5 is known from D1 pg. 3 lines 3-15, 26-28, pg. 4 lines 1-11; Fig 1 and also pg. 6 , Fig. 3, pg. 6 lines 1-15 which discloses a data processor comprising an array of unit cells of different types (ibid. pg. 3), there being a plurality of cells of each of said different types (ibid. pg. 3), each unit cell having first and second distinguishable states (ibid. pg. 3), and means for independently addressing the different types of unit cell with a state transformation

signal to which each addressed unit cell responds by selectively undergoing a state transformation in dependence upon whether its nearest neighbours are in mutually the same state or mutually different states (ibid. "field" and pg. 8).

5.1 As to claim 6, D1 also discloses a data processor according to claim 1,2,3 4 or 5 wherein data bits are represented on the array as patterns of said first and second states, each data bit being represented by a pattern of states formed by a plurality of adjacent unit cells (ibid. and pg. 5 lines 25-26).

5.2 Hence the subject matter of claims 1-6 lacks novelty over D1.

5.3 As to claim 7, D1 fails to disclose that 4 adjacent unit cells are used to encode a data bit. However, it is clear from D1 alone that the particular number chosen in D1 (2 adjacent cells) is by no means fundamental to the approach. One may rather choose any other physically feasible number of cells, such as e.g. four. The subject matter of claim 7 must thus be regarded as lacking an inventive step.

5.4 The same comment applies to claim 8: the skilled person is aware of different encodings for the fundamental data bits. Choosing the specific combination must be regarded as a non-inventive selection among equally possible alternatives.

5.5 Hence the subject matter of claims 7-8 lacks an inventive step over D1.

5.6 As to claim 9, D1 discloses how to simultaneously address all unit cells of a given type in dependence of the state of its nearest neighbours.

Furthermore, the feature of "simultaneously addressing all unit cells of the array with a state transformation signal to which all the unit cells respond" could also be interpreted as defining a (known) clock signal for cellular automata.

Hence the subject matter of claim 9 lacks novelty over D1.

5.7 As to claim 10, D1 discloses an inversion (cf. pg. 5 line 22). Hence the subject matter of claim 10 lacks novelty over D1.

5.8 As to claim 11, D1 fails to disclose the claimed loading means. However such loading means are known from D2 (Fig. 4, section 3.2) and the skilled person would be aware of the need to provide loading means to the system of D1. Loading data at the edges is clearly advantageous concerning geometrical and physical accessibility. In an attempt to provide loading means the skilled person would scan the relevant literature and find an advantageous solution in the disclosure of D2. The subject matter of the claim is thus not inventive over D1+D2.

5.9 The additional subject matter of claims 12 must be regarded as trivial over D1+D2: loading data bits in any conceivable pattern is well within the reach of the skilled person. The subject matter thus lacks an inventive step over D1+D2.

5.10 The subject matter of claims 13-16 is novel over D1 which does not disclose the use of a "control unit". However, the statements made in the description on pg. 7, lines 12-15 imply that control units are known from similar approaches. Claim 13 thus would appear to lack an inventive step.

In addition, the loading of the input data described in D2, section 3.2 might be interpreted as "loading a control unit": the actual processing to take place according to D1 and D2 is "controlled" (in the sense of "defined") through the input data). Since the claimed "control unit" may be regarded as nothing more than additional "input units" the comments made in 5.8-5.9 above also apply to claims 13-15 (D2 also discloses the use of six adjacent unit cells as a "control unit": cf. Fig. 4a, input at left hand side of QCA: 6 cells are physically connected to the QCA, inputting any pattern combination such as "110011" must be regarded as being trivial for the skilled person). Claims 13-15 are thus not inventive.

5.11 Claim 16 contains enough subject matter to exclude the above interpretation of the term "control unit". In particular, the available prior art does not contain any hint at using a plurality of labelled control units to be manipulated independently by a computational process. The claimed subject matter is thus not made obvious by the available prior art.

6 The same observation is true for claim 17 and the dependent claims 18-23.

7 As to claim 24 (depending also on claims 1-15): D1 discloses the use of a Java applet to simulate the networks (D1, pg. 3 lines 21-22, ref. [15]). The subject matter of the claim thus lacks novelty over D1.

7.1 As to claims 25-26,28 (depending also on claims 1-15): D1 discloses a proposal for a quantum computer applying unitary transforms by using electromagnetic radiation to flip spins in quantum systems consisting of non-zero-spin nuclei of donor impurity atoms in a semiconductor (cf. D1, pg. 8 lines 11-19). The subject matter of claims 25-26,28 thus lacks novelty over D1.

7.2 As to claim 26 (depending also on claims 1-15): D1 fails to disclose the use of molecules instead of donor impurity atoms. However using molecules must be regarded as an obvious design alternative (especially after considering the use of polymers in similar architectures, cf. also the statements made on pg. 2 line 1).

Re Item VII
Certain defects in the international application

8 Claim 29 violates various formal requirements of the PCT, most notably Rule 6.2(a) PCT: defining the subject matter through references to the description and drawings is certainly not necessary in the present case (as is demonstrated also by claims 1-28). Furthermore: the claim is not drafted in terms of the technical features of the invention (Art. 6 PCT and Rule 6.3(a)) and contains vague expressions ("*substantially* as .. described", Art. 6 PCT).

9 The description contains contradictory statements concerning the number of types of unit cells employed in the present invention: pg. 11 lines 26-29 (any number) vs. pg. 13 lines 16-17 (only two types, because of the significant advantages of using only two types). This is also reflected by the independent claims 1 (only two types), 5 and 17 (any number). Contradictions need to be eliminated (taking heed of Art. 34.2(b) PCT).

10 The application contains 4 independent claims (1,5,17,29) having overlapping scope. It does not seem that such a multiplicity of independent claims is necessary in the present case and hence the requirements of Rule 6.1(a) PCT

appear to be violated; furthermore the set of claims as a whole is not clear and concise (due to the number of claims having overlapping scope, Art. 6 PCT).

11 The independent claims are not in the two-part form in accordance with Rule 6.3 (b), (i), (ii) PCT, having a pre-characterising portion which correctly reflects the prior art of document D1.

12 Contrary to the requirements of Rule 5.1 (a) (ii) PCT, the cited document D1 is neither acknowledged nor briefly discussed in the opening part of the description.

13 The claims are not provided with reference signs placed in parentheses relating to the technical features referred to therein, Rule 6.2 (b) PCT.

14 The opening part of the description should be modified to bring it into agreement with any amended independent claim, Rule 5.1 (a) (iii) PCT.

Re Item VIII
Certain observations on the international application

15 The general indications in the introduction (on pg. 4, lines 13-15) to the effect that

(a) unit cells of the same type may also be addressed individually (pg. 4 line 13)
(b) irrespective of the states of the neighbours (cf. pg. 4 line 15)

must be regarded as contradictory to the actual disclosure and teachings of the document as a whole because:

(1) not a single embodiment appears to be described which would imply such a functionality: in fact, switching off the influence of the neighbours is impossible in the physical systems (cf. also pg. 2 lines 13-15) and the software simulations also imply these interaction effects (cf. pp. 12-13);
(2) in addition, the actual advantages of the present invention mainly rely in the global addressing approach (cf. pg. 13 lines 29-31, a passage which clearly states that and why global, not individual, addressing is used).

(3) The consistently used notation A_f^U (cf. pg. 6 lines 27-28) clearly indicates that only the global transforms (transform U for all cells of type A) in dependence of the state of the nearest neighbours (if state is f) are envisaged.

(4) Global addressing is also implied by the suggestions for physical implementation of the cells discussed on pages 7 and 12-13.

(5) Global addressing is one of the main reasons for the need of a control unit to access individual data bits (cf. pg. 7 lines 12-15). The control unit is employed in all embodiments (cf. Figs. 2-5) apart from the shifting operation of Fig. 1 which, however, is also explicitly based on addressing unit cells globally and in dependence of the state of the neighbouring cells.

16 Claims 1,5,9 and 17 fail to unambiguously include the essential feature that the updates are sent (cf. also pg. 7 lines 12-15)

(a) globally to all unit cells of a particular type and

(b) in dependence of the nearest neighbours states of the unit cells (as e.g. the resonant frequencies of a unit cell are determined by these states)

Even though the description contains individual statements (at pg. 4) which appear to relax the above constraints these statements must be regarded as contradictory to the actual disclosure of the application (cf. paragraph 15).

Hence, the description does not provide a basis for the wording of claims 1,5,9 and 17. Notably there is no basis for the expression "a state transformation signal to which each addressed unit cell responds" which also covers the possibility of addressing unit cells of the same type individually and irrespective of the state of the neighbours (cf. also claim 9). Only a formulation similar to "A global state transformation signal addresses all unit cells of a corresponding type in dependence of the state of the respective nearest neighbours of said unit cells. Each addressed unit cell responds to said global state transformation signal by..." would be in agreement with the teachings of the description as a whole, from which it is clear that this functionality *must* be present.

17 In order to facilitate the examination of the conformity of a possibly amended application with the requirements of Article 34(2)(b) PCT, the applicant is requested to clearly identify the amendments carried out, no matter whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see also Rule 66.8(a) PCT). If the applicant regards it as appropriate these additional indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
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(21) International Application Number: PCT/GB00/02573

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9916209.1 9 July 1999 (09.07.1999) GB

09-Jan-2002/30 mos.,

(71) Applicant *(for all designated States except US)*: **ISIS INNOVATION LIMITED** [GB/GB]; Ewert House, Ewert Place, Summertown, Oxford OX2 7BZ (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **BENJAMIN, Simon, Charles** [GB/GB]; Department of Physics, University of Oxford, Parks Road, Oxford OX1 3PJ (GB).

(74) Agents: **NICHOLLS, Michael, John** et al.; J.A. Kemp & Co., 14 South Square, Gray's Inn, London WC1R 5LX (GB).

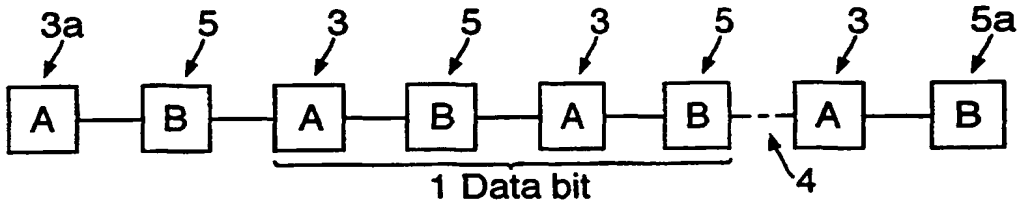
(81) Designated States *(national)*: JP, US.

(84) Designated States *(regional)*: European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: DATA PROCESSOR



(57) **Abstract:** A data processor which comprises a line of unit cells of alternating type, each capable of adopting two distinguishable states. The states of the cells of each respective type can be transformed (e.g. switched from one state to the other) by respective stimulae (which act on all cells of that type simultaneously) in dependence upon whether the cells two nearest neighbours in the line are both in mutually the same state or in mutually different states. Binary data bits are each represented by a pattern of states of four adjacent cells, and data is loaded onto the cells so that each bit is spaced by four cells from an adjacent bit. Logical operations can be performed on the data by loading a control unit (a particular pattern of states of six adjacent cells) and then applying the stimulae to transform the states of the cells. The processor can be implemented on a conventional computer by implementing the cells as Boolean variables in an array with the stimulae being update rules applied to the array. Alternatively the processor can be implemented as a quantum computer in which the cells are quantum systems (e.g. quantum dots, trapped ions, atomic or molecular spins) which have two eigenstates.

WO 01/04835 A1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/02573

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06N1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
INSPEC, EPO-Internal, WPI Data, PAJ, IBM-TDB, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	INTERNET http://xxx.lanl.gov/pdf/cond-mat/9808243 21 august 1998 "Cellular Structures for Computation in the Quantum Regime" S.C. Benjamin and N.F. Johnson XP002149950	1-6,9, 10,25-29
Y	page 2, line 1 -page 8, line 19; figures 1-3	7,11,17
A		8,12-16, 18-24

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2000	30/10/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Schenkels, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 00/02573

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	LENT C S ET AL: "Quantum cellular automata" NANOTECHNOLOGY, JAN. 1993, UK, vol. 4, no. 1, pages 49-57, XP000946209 ISSN: 0957-4484 abstract page 50, left-hand column, line 14 - line 30 page 53, right-hand column, line 23 - line 50; figure 4 ---	7,11,17
P,X	BENJAMIN S C: "Schemes for parallel quantum computation without local control of qubits" PHYSICAL REVIEW A (ATOMIC, MOLECULAR, AND OPTICAL PHYSICS), FEB. 2000, APS THROUGH AIP, USA, vol. 61, no. 2, pages 020301/1-4, XP000915374 ISSN: 1050-2947 the whole document ---	1,5,17, 29
A	DE 197 24 313 A (EISENBERG WOLFGANG DR ;KIEFER CLEMENS DR (DE); RENNER UWE DR (DE)) 17 December 1998 (1998-12-17) abstract ---	24
A	BENJAMIN S C ET AL: "A possible nanometer-scale computing device based on an adding cellular automaton" APPLIED PHYSICS LETTERS, 28 APRIL 1997, AIP, USA, vol. 70, no. 17, pages 2321-2323, XP002149949 ISSN: 0003-6951 the whole document -----	1,5,17, 29

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[redacted]on patent family members

Interna[redacted] Application No
PCT/GB 00/02573

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19724313 A	17-12-1998	NONE	

The Patent Office

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Isis Innovation Limited
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Examiner: 01633 814417
†**E-mail:** leslie.middleton@ukpats.org.uk
Switchboard: 01633 814000
Fax: 01633 814444

Your Reference: N.76350 MN
Application No: GB 9916209.1

4 February 2000

Dear Sirs

Patents Act 1977: Search Report under Section 17(5)

I enclose two copies of my search report and two copies of the citations.

Plurality of invention

The ambiguity of the definition on page 4 of the term "unit cells", and the use of this term to mean two quite different things in the claims, depending on the two different embodiments described, that is the quantum computer and the so-called classical computer, as well as the statement of invention bridging pages 2 and 3, makes it impossible at this stage to determine whether or not the claims are directed to a single invention or inventive concept.

However, no further action in this respect will be taken at this stage, but the matter will be considered if, and when, a substantive examination is made.

Publication

I estimate that, provided you have met all formal requirements, preparations for publication of your application will be completed soon after **5 December 2000**. You will then receive a letter informing you of completion and telling you the publication number and date of publication.

Amendment/withdrawal

If you wish to file amended claims for inclusion with the published application, or to withdraw the application to prevent publication, you must do so before the preparations for publication are completed. **No reminder will be issued.** If you write to the Office less than 3 weeks before the above completion date, please mark your letter prominently: **"URGENT - PUBLICATION IMMINENT"**.

Yours faithfully

L Middleton

Leslie Middleton
Examiner

---

†**Use of E-mail:** Please note that under patent law e-mail may be used to file correspondence only.

Application No:	GB 9916209.1	**Examiner:**	Leslie Middleton
Claims searched:	1	**Date of search:**	3 February 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): G4A (AMP, ASX)

Int Cl (Ed.7): G06F 15/80

Other: Online: EPODOC, PAJ, WPI / EPOQUE

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 99/53410 A1 (Silicon Graphics)	
A	EP 0920149 A2 (Motoyoshi et al)	
A	EP 0697737 A1 (IBM)	
X	WO 92/03802 A1 (Sec. Defence UK) Fig 5 & description	1 at least
A	US 5768297 A (Shor)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.